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An Experiment in Linear Space Perception. By FRANCIS NORTON MAXFIELD. Psychological Review Monographs, XV (whole No. 64), 1913. pp. 56.

The purpose of the experimenter has been to apply in another sense field, the statistical methods outlined in F. M. Urban's treatise. (The Application of Statistical Methods to the Problems of Psychophysics, 1908.) Dr. Maxfield works in the field of visual perception and, more particularly, the perception of small differences in the length of lines. His material consisted of a series of seven pairs of lines; each pair composed of a standard line 150 printer's points long, and a comparison stimulus from the series 144, 146, 148, 150, 152, 154, and 156 points long. These were exposed on a rotating drum, and in every case a standard and comparison stimulus were exposed simultaneously; the standard being always to the left. The time of exposure was approximately $1\frac{1}{2}$ seconds. Great care was taken to keep the objective conditions constant. Judgments were given on each pair of stimuli in terms of the three categories "equal," "longer" and "shorter." In all, twelve subjects were used and 3,500 judgments were obtained from each of them.

These records enable the experimenter to obtain the absolute and relative frequencies with which the various categories occur for the different comparison stimuli. Dr. Maxfield applies the coefficient of divergence of Lexis and Dormoy in order to ascertain to what extent the conditions influencing the judgment given remain constant throughout the experiment. He obtains in every case a fairly large supranormal dispersion which indicates changes in these conditions. This, the author believes, may be explained by the fact that none of the subjects had any training in the technique of this particular experiment and, indeed, half of them had never had any training in a psychological laboratory. In fact he finds that the coefficients for the group of untrained subjects are very much larger than for the subjects who had had former psychological training.

By interpolation according to Lagrange's formula, the author next calculates certain intermediate values of the probabilities with which we may expect our three categories of judgment on the values of the comparison stimulus between those which have been empirically determined. He then constructs the curves for the psychometric functions for all twelve subjects, and the article includes the graphs for all of them. These graphs show clearly the great individual differences in the subjects.

The next consideration is the relation of the method of just perceptible differences to these empirical results. The author obtains two series of values of the thresholds. One series was calculated on the basis of the probabilities of the different judgments; and the other was derived from observed values of the just perceptible and just imperceptible positive and negative differences. There is a close correspondence between the values of the interval of uncertainty which were found by interpolation, and those which were calculated by the method of just perceptible differences. A comparison between the observed and theoretical values of the method of just perceptible differences shows less correspondence, due probably to great variations among the different subjects in sensitivity to the objective relations of the stimuli.

The rest of the paper is devoted to a consideration of the equality judgments. Dr. Maxfield finds a marked regularity in the ordering

of his subjects, when he compares the value of the probable error with the value of the maximum probability of the equality judgments. When dealing with the second of these his subjects fall into an order which is almost the exact reciprocal of their order by the value of the probable error. Other serial arrangements are made, as in Urban's Monograph, on the basis of the length of the interval of uncertainty by the method of just perceptible difference and by interpolation, the probable error of the mean of the equality judgments, and the probable error of a single equality determination. Some degree of regularity is apparent in these comparisons.

This study is extremely interesting for the reason that it shows that Urban's notions as regards the psychometric functions, and all the notions derived from that concept, are valid in another sense field than that of lifted weights. The experimental arrangement is ingenious and should be applicable in the future to many experiments in the visual field. The author's presentation of his material is very clear and concise.

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SAMUEL W. FERNBERGER.

On the Relation of the Methods of Just Perceptible Differences and Constant Stimuli. By SAMUEL W. FERNBERGER, PH. D. Psychological Review Monograph Series, XIV, No. 4, 1913. pp. 81. Price \$1.

The formal character of the two methods having been shown to be identical there remains only the problem of the variations due to the experimental procedure. Fernberger's conclusions are based on lifted weight experiments which were conducted so that the space error was eliminated and the time error was constant in the first order. Seven comparison weights were used, six of which, for the method of constant stimuli, were constant in intensity and the seventh, for the method of just perceptible difference, was variable. No information was allowed the subject in reference to the weight lifted so that there could be no anticipation as to the outcome of the judgment. In the results obtained by the method of constant stimuli the effect of practice is clearly seen. Fernberger calculated the coefficient of divergence and finds a slightly over-normal dispersion which shows that the conditions did not remain absolutely constant. Since the experimental arrangement was such that a change in the objective conditions was very unlikely we must suppose that a change in the psychophysical constitution of the subject took place. Through the course of the curves plotted for the value h , in the successive series, the author is able to conclude that the variation in the distribution of the judgments is due to the state of practice of the subject. Then he shows, by a comparison of these results with results obtained from one of his subjects in a previous investigation, that this practice effect is not due to a definite training of the sensory apparatus involved but to a more consistent concentration of the attention on the task. In the method of just perceptible difference an important element is the attitude of the subject when he knows he is going through a descending or an ascending series. The use of alternate series and their presentation simultaneously with the series for the method of constant stimuli tended to neutralize the errors due to this condition of the subject.

A comparison of the two methods is the main issue of the article. It has been shown by Urban "that the common source of both